

A Study on Creation of Industry 5.0: New Innovations using big data through artificial intelligence, Internet of Things and next-origination technology policy

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Abstract - Industry 5.0 aims to achieve efficient and user-friendly production solutions as compared to Industry 4.0 through the integration of human expertise, efficient, intelligent, and precise devices. The development of many leading-edge technologies and applications assists Industry 5.0 in expanding production and delivering customer-specific products axiomatically. This article aims to provide the first in-depth discussion of Industry 5.0 through research-based lessons on possible applications and enabling technologies. Using examples of earlier industrial revolutions and industrialists' perspectives, we present several new concepts and definitions of Industry 5.0. We then discussed the specifics of Industry 5.0 applications such as smart health care, cloud manufacturing, asset management, etc. Next, also discussed about Edge computing, digital twins, interactive robots, the Internet of Things, blockchain, and 6G are just some of the technologies that can support this.

Keywords—Industrial Revolution, Big data, Artificial Intelligence (AI), IoT, Industry5.0.

I. INTRODUCTION

Since the earliest industrial revolution, humans understood advancement can be achieved through the use of technology. There have been many developments in the last few centuries, such as steam plants, assembly lines, and computers, developed in command to upsurge productivity and proficiency as well as speed up growth. The industrial revolution brought changes to the economy and society. Industry 5.0 transforms this paradigm and creates change by reducing technological stress and assuming that the true power of progress lies in the interaction amongst guy and apparatus. The previous level, Industry 4.0, emerged with the advent of automation technology, IoT, and smart factories. Industry 5.0 takes the next step, which is to harness the interplay between powerful and precise machines and the distinctive power of human production, where homosapiens can combine their imaginations with technology and machines. Production challenges can be overcome with digital technology that includes an artificial intelligence-based system. By using this artificial intelligence-based program and increased productivity can be achieved with minimal human effort [1] [2].

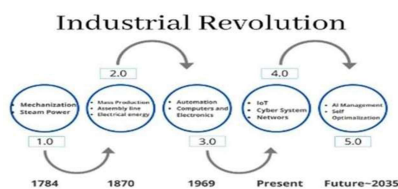


Fig: 1- Industrial Revolution

Industry 1.0 – It was the chief industrial revolution, initiating the transition to new manufacturing's systems using water and steam. There was a great gain in terms of having more variety of goods and building a better quality of life for others. The textile industry in particular was industrialized, as was travel. Their use for manufacturing resolutions was the utmost breakthrough in accumulative mortal efficiency. Instead of looms powered by human power, steam engines could be used for power. This First Industrial Revolution marked the transition from agriculture and the handicraft economy to mechanized domination and had a profound impact on industries such as mining, textiles, glass and agriculture. Innovations such as a steam engine, a spinning wheel, and a water wheel altered the production surface and set the tone for the current system. This revolution led to the 1833 Factory Act, which placed restrictions on the working hours of children and set standards to protect workers. This era was primarily pigeonholed by the physique espousal of condensation technology and strong and the move from agriculture to industry. The period for this revolution began in the 1790s and was mostly confined to Britain. Industry 1.0 can also be considered as the commencement of the industry values which riveted equally on eminence, proficiency and scale [3]

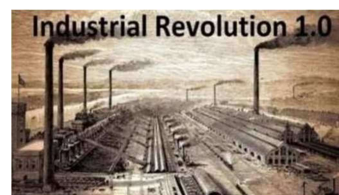


fig -2 Industrial Revolution 1.0

Application of Industries 1.0:

1. The routine of fresh rudimentary constituents, especially metal and steel.
2. Utilization of renewable liveliness springs, including energies and renewable energy sources, such as coal, steam engine, electricity, petroleum, and indoor combustion engine.
3. The introduction of new tackles, such as spiraling jenny and power loom that allow for increased production at minimal cost of human energy.
4. A new labor union notorious as the workshop system, which combines additional labor diversity and labor specialization.
5. Significant improvements in transportation and communications, including train, steamship, car, airplane, telephone, and radio.
6. Enhanced Cultural transformations of a broad order

Disadvantages of Industry 1.0

1. It creates a higher level of pollution in the environment.
2. The Industrial Revolution appropriates materials from natural use to human use.
3. Less Healthy Lifestyle due to air pollution.
4. Exploitation of women and children's workers as started working for long hours.

Industry 2.0 – After the 1840s, it was the time when the second revolution took place. It instigated in the 19th era with the unearthing of voltage and assemblage streak creation. Introduction of electricity was authorized in factories to develop modern production lines. While a station used to assemble a complete automobile, the vehicles were now produced in stages on the assembly line - suggestively faster and more cost-effectively. Some historians have also commonly referred to it as the Technological Revolution. In this era, some of the new electrical technologies were introduced to meet the challenges of productivity or efficiency duration.

Mass fabrication of belongings using gathering contour became as a customary rehearsal. This period also saw the emergence of an industrial culture introduced in Industry 1.0 in the management system to improve the efficiency of production facilities in the numerous invention administration strategies such as labor segregation, timely production and inefficient production systems refine the basic processes that lead to quality and outcome improvement. American mechanical engineer Fredrick Taylor presented research into how to improve employee performance, workplace strategies and resource allocation.

The Second Industrial Revolution was a period of appreciable monetary progression, with an increase in productivity. The Second Industrial Revolution, also identified as the Technological Revolution, was a retro of speedy methodical discovery, establishment, mass production, and industry from the late 19th century to the early 20th century. Advances in manufacturing and manufacturing technologies have made widespread use of technological systems such as telephone and railway linkages, gas and marine supply, and sanitation systems, which have been concentrated in a few selected cities. The massive enlargement of railway and telegraph lines after 1870 allowed for unprecedented movement of people and ideas, culminating in a new wave of globalization. At the identical time, new technological systems were developed, in particular electrical power and telecommunications. The Second Industrial Revolution continued into the 20th century with the introduction of the first industrial power supply and fabrication line, and terminated at the establishment of World War I. [4].

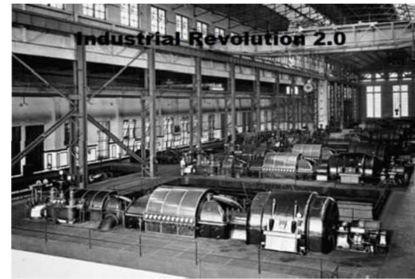


fig -3 Industrial Revolution 2.0

Application of Industries 2.0:

1. The journey of electric motors began with a new phase.
2. There was a revolution in battery life.
3. New technological systems are introduced, such as high-tech electronics that allow for mass production and sophisticated equipment.
4. Moving integration lines were developed in the production concept.
5. Production rate increased and time decreased.

Disadvantages of Industry 2.0

1. Increment in growth of unregulated child labor.
2. Increased Unemployment
3. High Capital cost and need extra charges (since electric trains need third rails or overhead wires).

Industry 3.0 – It was the third revolution, introduced in the 1970s, in which the use of information technology and electronics was implemented. We can say that it started with

the first computing era when automation work started in manufacturing, production, or such fields. A crucial opinion of this stage is the mass fabrication and widespread using digital logic, MOS transistors, and integrated circuit chips, as well as the technology based on them, including computer machines, CPUs, digital mobile handsets, and the Internet. The community was first familiarized with the concept that directed to the Internet was when a message sent over the ARPANET in 1969 which was the duration of Industry 3.0. These new technologies have transmuted traditional production and business processes with a great change. Basically, we can say that third revolution has transformed analog system into a digital format. Integrated circuits and transistors are highly efficient, resulting in decreased effort in the development and production of electronic devices, augmented speed, grander accuracy and even comprehensive substitution of humanoid negotiator in some instance. The Programmable Logic Controller (PLC), which was first erected in the 1960s, was one of the landmarks of electronics. Sincethe introduction of these machineries, we have been able to systematize a perfect production process - without human help. Well-known specimens of this are robots that execute programmed sequences deprived of human intervention. The discovery of nuclear energy also takes place during this phase only. These technological revolutions malformed outmoded construction and business techniques. The development of the Z1 processor, which used the numbers of dual floating points and the Boolean mind, a decade later, marked the beginning of the most advanced digital development. The next significant breakthrough in communication technology was the supercomputer, which makes widespread use of processor and communication technology in the production system; machines initiated to eliminate the necessity for human energy. [5]



fig -4 Industrial Revolution 3.0

Application of Industries 3.0

1. Bulk customization begins with the idea of production.
2. Access to the Internet and the World Wide Web.
3. Emerging PLCs and microprocessors.
4. Business software development has begun.

5. It used electrical equipment.

Disadvantages of Industry 3.0

1. Increased Unemployment.
2. Uncertain future of factories
3. Manufacturing jobs or employment require more highly proficient skills which causes job loss.
4. Inequality between urban and rural areas.

Industry 4.0 – It is the fourth industrial revolution or we can say the time of the smart machines, robots, artificial intelligence, or many other technologies. The Fourth Industrial Revolution, 4IR, or Industrial 4.0 consider rapid changes in technologies, industries, and social patterns and progressions in the 21st century as a result of increased communication and smart automation in the new era.

The scope of an embedded system or an automation system rises on the peak as it reduced human power and also increases productivity and efficiency along with the increment inaccuracy. Part of this chapter of industrial modificationis the mixing of technologies such as artificial intelligence, genetic engineering, internet of things, telecommunication, and advanced robots that narrow the lines amongst the physical, digital, and genetic worlds. Exchange of Data or information from users to machines and machines to users started using the help of IoT. Industry

4.0 Uses Replicated Corporeal Schemes to segment, examine and direct intelligent actions of numerous developments in the engineering to make apparatuses cleverer. These smart devices can continuously monitor, perceive and envisage faults in order to propose precautionary measures and corrective action. This allows for better readiness and less time for industrialization.

The same energetic tactic can be deciphered into other facets of the diligence such as asset flow, production planning, product output efficiency, quality control, power consumption and improved efficiency. Industrial 4.0 technology provided operators with extensive information to make decisions. Inter-connectivity consents operatives to accumulate large expanses of data and information at all points in the production process, identifying key areas that can benefitfrom development to maximize efficiency.

It was also considered as that the fourth Industrial Revolution inscriptions to the commencement of the Imagination Age. Some of thecomponents that were started during 4th Industrial revolution operation are like Smart Sensors, Augmented wearable devices, mobile devices, advanced human-machinesinterfaces and etc.[18]



fig -5 Industrial Revolution 4.0

Application of Industries 4.0:

1. Better analysis of problem areas.
2. Establishment of Highly Flexible Production.
3. A journey to switch to sustainable production.
4. The emergence of a smart factory concept.
5. Integration of equipment, people, processes and infrastructure.

Disadvantage of Industry 4.0

1. Cyber security Risk
2. Increment in Ethical issues
3. Core industries disruptions
4. Paradigm shift in technology policy.

Industry 5.0 – It’s a Fifth Revolution of this era that can be started from upcoming 2023. There will be every industrial production, manufacturing with the help of Robotics and advanced smart technologies. As the IoT plays a key role in exchanging data and information between hardware and software using dashboards, this revolution is set to focus on the reoccurrence of human hands and thinking to industrial frameworks. The new beginning of Industry 5.0 takes our era towards new society i.e., Society 5.0, which is also known as the super-smart society, which may be the final bridge between machine and man. The aim of Industry 5.0 is to interdependence of man and machines using cognitive totaling and anthropoid astuteness which will approach towards the figure customization and personalization for humans. The introduction of Industry 5.0 in conjunction with society 5.0 may lead to robots and drones delivering medical supplies, meals, and medicines to patients infected with disease. Medical, rapid diagnostics, reconnaissance and observing, development of personal protective equipment novel novels, and vaccine development are all advancing thanks to nanotechnology, the surreptitious to the fifth industrialized rebellion and the forthcoming. There will be innovative



fig -6 Industry 5.0

Application of industry 5.0

1. Close interaction between humans and machines.
2. The advent of 5G will allow manufacturers to become more aware of mobile operators.
3. Emphasize more in object building and culture - mass production.
4. Additional use of cloud robots and easy-to-use remote robots APIs.
5. Era of Internet of Everything.
6. Beginning of Digital Market.
7. Self-monitoring and feedback control.
8. Real-time productivity optimization.
9. Smart healthcare and agriculture
10. Emergent Artificial Intelligence As we are discussing about the various industrial revolution it seems that every revolution has its own specialty and innovation which present them in their own unique identity.

Industry 1.0 – Mechanization

Industry 2.0 – Electrification

Industry 3.0 – Automation

Industry 4.0 – Digitalization

Industry 5.0 – Personalization

Sr. No.	Industry	Revolution Duration	Area	Benefits	Limitation
1	1.0	1780-1868	Steam and Water Based Power Machines.	Revolution in transportation and traveling using mechanization.	Limited Features, Expensive Machinery, High Maintenance, Air Pollution
2	2.0	1870-1914	Electrical Energy, Assembly lines, and Mass production.	Electric Engines, Electric Boilers.	Expensive Electricity Charges, High Energy Consumption
3	3.0	1969-2010	Electronics Machines, Computer System, Automation	Accurate Machinery, Less Power Consuming, and Reduced Manpower	Consuming more space, requires fast internet, limited speed processing
4	4.0	2011 – till now	Robotics, Cyber System, Network, AI, IoT	High Accurate Working, Cost-Efficient, Smart Working	Cyber-attacks, ethical issues,
5	5.0	Approx. in 2025	Self-optimization, AI management, Io E, Blockchain	Fully Automation Controlled System, Fast and Reliable Working, High Security	-----

Table-1: Comparison of various industries

II. Technological transitions from industry 4.0

to 5.0

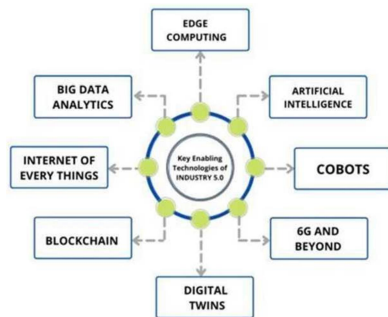


fig 7: Roots of Industry 5.0

Industry 5.0 has its roots in the notion of Industry 4.0 as a future project and fragment of the nation's high-tech tactic to be embraced by science and technology, society and decision-makers together. It was originally linked to how and to what extent the country had managed to keep the number of

producing people largely stable in the first epoch of the 21st span and how it could be more and more abundant in the coming decades. [6]

Edge Computing - Edge computing is dispersed computer computing that brings calculations and data storage closer to data sources. This is anticipated to upgrade response times and save bandwidth. The communal misapprehension is that edge and IoT are the same. Edge computing is a form of topology- and a disseminated computing environment, while IoT is the use of edge computing.

Edge computing moves part of the storage and counts resources out of the central data center and approaches the data source itself. Rather than transferring raw data to a central data epicenter for processing and analysis, that function is performed where the data is actually produced - whether it is a retail store, factory location, growing facility or intelligent city. The only result of that end-to-end computer activity, such as real-time business data, machine maintenance predictions or other possible responses, is returned to the main data center for review and other human interactions.

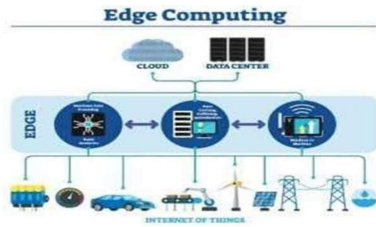


fig 8: Edge Computing

In many cases, it can be very helpful to manage the data on the device where it is produced. This is why edge computing comes into play. Edge computing helps separate data processing and cloud computing. Edge computing is all a matter of location. [7]

- **Artificial Intelligence** - Artificial intelligence is the intelligence manifested by machines, as opposed to the natural intelligence manifested by animals including humans. Or can say that the AI field is a study of "intelligent things": any system that recognizes its location and performs actions that increase its chances of achieving its goals some popular accounts use the term "artificial intelligence" to describe machines that mimic "mind" human activities. Those who associate it with the human mind, such as "learning" and "problem-solving", however, this definition is rejected by the great AI researchers. Typically, in artificial intelligence or in machine learning an algorithm takes a certain input

and uses mathematics and intelligence to produce output. In stark contrast, Artificial Intelligence Algorithm captures both combinations - input and outputs simultaneously to "read" data and produce results when given a new input.

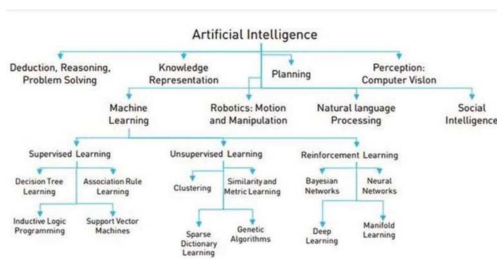


fig 9: Flow Chart of Various AI Algorithms

Artificial intelligence is a theory and development of computer programs that can perform tasks that often require human ingenuity. Speech recognition, decision making, visual perception, for example, aspects of human intelligence and practical skills they may have. And artificial intelligence compares with instinct.

Cobots - Cobots Interactive Robots are cost-effective, safe, and flexible to use. Collaborative robots - or cobots - make self-defense easier than ever, even for small and medium-sized companies around the world. Cobots are designed to share a work environment with people, making changing them easier than ever. Cobot's applications contrast with traditional industrial robot applications in which robots are isolated from human contact.



fig 10: Cobot's Structure

The automation of production processes is a factor and will be an important factor in increasing productivity in the future. Companies that aim to grow and be competitive will integrate robots to make them work better and improve their operations. Robots work best when the business objective is to increase production capacity, increase product quality, reduce production time or make production more flexible.

6G - 6G is the sixth-generation wireless communication technology standard that supports mobile data networks. It is a fixed 5G fan and probably very fast. The eventual goal is to replace or work alongside 5G networks and will offer significantly faster transmissions, at speeds of ~95 Gbit/s. Terahertz communications are one of the key elements of a 6G.



fig 11: The connection deployed by 6G between PH, HW, DW

6G will have a major impact on many government and industry approaches to public safety and security of important assets such as threat detection, health monitoring, face recognition, AQI measurements, gas sensitivity and toxicity, etc. [8]

- *Digital Twins* - A digital twin is a virtual picture that serves as the real-time digital complement of a physical object or course. Digital doubles are the result of frequent development in the creation of product design and engineering actions, for example, 3D Modeling is the best example of digital twins.



fig 12: 3D model

The digital twins, who identified the digital copy of the engine produced in their factories, are now a reality in many industries. These digital twins can be used for a variety of purposes, simulation and monitoring are obviously common applications. The growth of digital twins is fueled by digital growth in the design phase that eventually produces a digital copy of the final product, the digital copy used in factory production through robots and other digital forms. controlled production tools. [3]

- *Blockchain* - In a blockchain, records are linked together using cryptography into a growing list, called blocks. Typically, blockchains are managed by peer-to-peer networks that serve as a publicly distributed ledger, where nodes are required to adhere to a protocol to communicate and validate new blocks. Since blockchain data cannot be altered retroactively, the data in any given block cannot be modified without affecting all subsequent blocks as well.

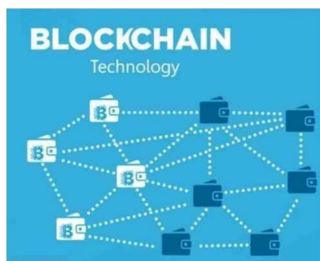


fig 13: Block Chain Tech

Blockchain technology is associated with crypto currencies like bitcoin and others. Blockchain technology allows consumers and providers to connect directly, eliminating the need for a third party. Provides a separate site or digital book for activities that everyone can see on the network. [9]

- *Internet Of Things* - In the Internet of Things, or IoT, computers, mechanical and digital machines, objects, animals, and people are connected via a network and can communicate over a network without needing to interact with humans or computers, for instance, a smart house, a smart polyhouse, etc.

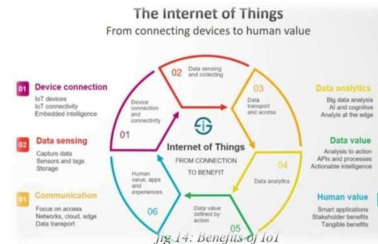


fig 14: Benefits of IoT

The term IoT is widely used on devices that often cannot be expected to have an internet connection, and be able to communicate with the network without human action. Communication between electronic devices was made easier due to IoT. We can access data and information without having to live in that exact location, in real time. And it may be due to the network of devices (Objects); one can access any information that resides in any part of the world using IoT. [10]

- *Bigdata Analytics* - Big data analysis explores large amounts of data to reveal hidden patterns, relationships, and other details. With today's technology, it is possible to analyze your data and get answers to it quickly - a slow and inefficient effort with common business intelligence solutions. Big Data has the potential to affect your data and get answers to it quickly - a slow and inefficient effort with common business intelligence solutions. Big Data has the potential to affect

- Retail,
- Manufacturing,
- Financial services,
- Research
- Education.



fig 15: Big Data Analytics

In figure-15 it is showing the seven V's of Big Data on which it depend's. It analyzes large data sets by distributed processing to provide quick action. Big data analysis is often a complex process of testing big data to reveal information - such as hidden patterns, relationships, market trends and customer preferences that can help organizations make informed business decisions. The main approach of big data is for filtering and analytics. Analytics is the invention, interpretation, and transmission of meaningful patterns in data.

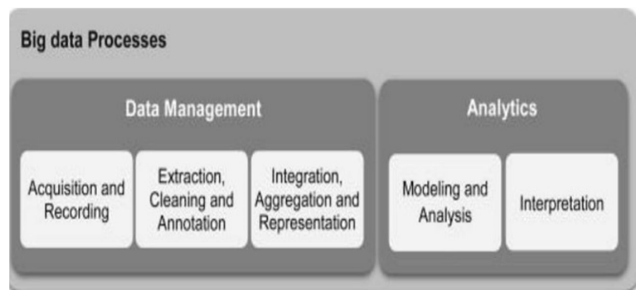


fig 16: Big data processes

Using the Embedded National Road Systems concept, acatech (German Academy of Engineering Sciences) proposed an exploration agenda and execution endorsements in 2013. Explain how the Internet of Things will influence the production organization in order to create a new source of interaction between humans and machines, as well as a new wave of automated applications. According to Deutsche Bank (2014), adopting Industry 4.0 means becoming a "factory worker". The founder, chairman, and CEO of the World Profitable Scene, Klaus Schwab, published two books in which he explained how Industrial 4.0 differs from previous industries' ideas, which were most evident in the progress of technology in terms of IoT, automation, networking, and artificial intelligence . In its ten ages of life, Industrial 4.0 has dedicated less on the imaginative ideologies of social righteousness and sustainability, and extra on digital and artificial intelligence implementation technology to increase efficiency and production flexibility.[7] [3]

The conception of Industry 5.0 delivers an exceptional focus and highlights the prominence of research as well innovation to sustenance the industry in its extensive-term mission to humanity within the planet's boundaries. The theories of Society 5.0 and Industry 5.0 are related in the sagacity that both concepts refer to an ultimate alteration of our society and economy towards a new paradigm. The perception of Society 5.0 was presented by Keidanren, in Japan around 2016. It has subsequently been promoted by the Japanese government. Also, Japan essentially takes the digitalization and renovation magnitudes, mainly situated on the level of individual organizations and parts of society, to a full national transformational stratagem, procedure, and even thinking. The concept of Industrial 5.0 was discussed between participants from research and technology organizations and funding agencies across Europe at two consultative conferences organized by the Directorate "Prosperity" of DG Research and Innovation, on 2 and 9 July 2020. The focus was very empowering. There was unanimity on the requirement to enhanced assimilate European social and environmental priorities into new technological practices and to shift the effort from one technology to a more strategic approach. Six stages have been notorious, both of which is painstaking to be an countenance of its combined strength, as a component of technical structures: [11] [12]

- Individual interaction with the machine
- Bio-persuade technology and intelligence
- Digital twins and constraints
- Data convey technology, storage, and analysis
- Artificial Intelligence
- Energy Efficient, Renewable, Maintenance and independent technology.

III. Comparison of techniques with application based on past publications:

S n	Author's	Industry	Tech used	Application
1	E. Anthony Wrigley [13] Peter Temin [14]	1.0	Use of steam power and mechanization of Production.	industrialized sectors as Iron industry, steam power, machine tools, chemicals, cement, glassmaking, agriculture, transportation
2	Muntone, Stephanie [15]	2.0	Use of ne technologies such as electrical power, telephones, internal	Developed sector as electrification, steel, rail, machine

			Combustion engine, gas, telegraph, sewage and water supply.	tools, maritime technology, bicycles, automobile, applied science, engines and turbines.
3	Jeremy Rifkin, Nicolas Easley, A. Tantawi, Sokolov and Tantawi [17]	3.0	Use of Automation era in production and emergence of computers and embedded systems.	Production sector got amazing growth in the field of engineering patch. Industries get automated in the entire production process without any human assistance.
4	F. Baena,	4.0	Installment of	Emergen

Table No: 2- Features and Applications of Industries

IV. Discussions

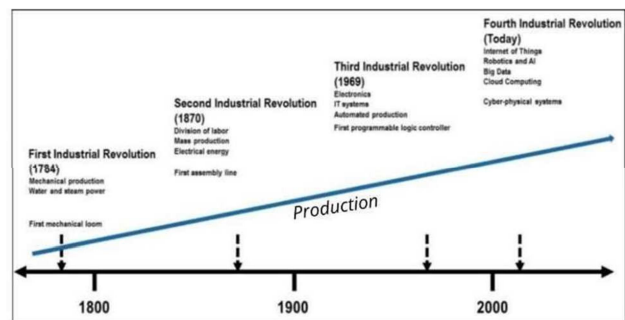
As industry 4.0 enters the manufacturing sector first under 10 years ago, but next change is now awaited Industry 5.0. Now the transformation is intended to focus on the return of the individual and minds in the urban world, by the transformation of factories in intelligent IoT compliant facilities psychological and integration processes communication. Industry 5.0 is the change that combines output methods with efficiency and finds methods for this communication between humans and machines. The connection between human intelligence and the intellect Computer is among the most important developments foretold since industry 5.0. People and computer machines are expected to advance the technology at unprecedented speed and perfection levels. Fifth technology can also sustain environmental sustainability, as companies build recovery and waste systems discard. With the

features of IoT Applications, cyber systems, and cognitive computing, we will see rapid growth as more businesses enter. A few years ago, human labor and factory robots could be depleted sharing projects and sharing projects a various production processes [5] [20].

	Industry 4.0	Industry 5.0
Motivation	Mass production and new factories	Sustainability and Social Economic, Self-optimization
Power Sources	Electrical Power, Fossil fuels	Solar Power, Renewable power sources
Latest Technology	IoT, cloud computing, big data, Artificial Intelligence	Human-Robot coordination, Bio nics, Sustainable Development Manufacturing, Renewable Resources
Covered Area	Business Administration, Organization Research, Process Improvement	Healthcare, Agriculture, Business administration, Research, Innovation, Reduction waste prevention

Table: 3 – Comparison of 4.0 and 5.0

The above table shows how the present scenario of industry 4.0 is working on various areas like business administration such as complexes, financial corporation and organizational research by using the latest technologies like IoT, artificial intelligence, robotics, big data and also shows how the awaited scenario of upcoming future of Industry 5.0 will be focusing on the area of making agriculture, healthcare, research innovations fully self-optimized and digitalized.



Graph 1

Here, in the given graph above, we can see the change in production in the last few decades. As the graph is showing the rise in the comparison of production it clearly shows that in the upcoming period how the development in the various Industrial revolutions is going to bring huge change. In 1784 the production process was under mechanical power and further in 1870 the production increased as shown in graph with the emergence of electrical energy and first assembly line. Also, we analyze how technologies have brought us to comfortable and advanced life in 1969 with the installments of IT systems and automated production, it was a great and vital change and so on further in today's scenario we can analyse that how the production is being increased with optimizing the proper timing. Starting from the first mechanical loom the production was very slow and further how the production and advancement increases and complexity decreases became terrible and outstanding.

V. Conclusion

In this paper, we have introduced a study on support for potential technologies and applications of Industrial 5.0. The study provided shows that the growing popularity of the digital economy and the countless number of real-world applications build a solid foundation for the development of Industrial 4.0 existing and long-term technology can serve as the founding pad of Society 5.0. In summary, Industry 5.0 is a notion that has been designed to harmonize the working space and efficiency of humans and machines consistently. Industry 5.0 is expected to increase manufacturing production and better customer satisfaction.

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